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STREAMGAGE FLOW RECORD ADJUSTMENT, CONESTOGA RIVER, LANCASTER, PENNSYLVANIA

SUSQUEHANNA RIVER BASIN COMMISSION

OCTOBER 1991

The Susquehanna River Basin Commission was created as an independent agency by a Federal-Interstate Compact* among the States of Maryland, New York, Commonwealth of Pennsylvania and the Federal Government. In creating the Commission, the Congress and State Legislatures formally recognized the water resources of the Susquehanna River basin as a regional asset vested with local, State and National interests for which all the parties share responsibility. As the single Federal-Interstate water resources agency with basinwide authority, the Commission's goal is to effect coordinated planning, conservation, management, utilization, development and control of basin water resources among the government and private sectors.

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* Statutory Citations: Federal - Pub. L. 91-575, 84 Stat. 1509 (December, 1970); Maryland - Natural Resources Sec. 8-301 (Michie 1974); New York - ECL Sec. 21-1301 (McKinney 1973); and Pennsylvania - 32 P.S. 820.1 (Supp. 1976).

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INTRODUCTION

The streamgage for the Conestoga River at Lancaster, Pa. is located downstream from the Lancaster municipal water supply intake. The USGS data for the streamgage reflects the flows after the water-supply withdrawal. In order to use these records for water resource management purposes, including regulatory purposes, the flows needed to be adjusted to account for the water-supply withdrawal, so that the adjusted values would then approximate the natural flows. This report describes procedures used by the Commission staff to adjust the records and presents analyses of the adjusted record.

PROCEDURE

The natural flows were estimated using two sources of data and types of information. The U.S. Geological Survey Water-Supply Papers No. 1722 and 1302 were used for the period October 1929 through September 1960, and the yearly U.S. Geological Survey Water-Data reports were used for the period October 1960 through September 1988.

The average daily withdrawal for the period October 1929 through September 1960 was estimated as follows:

1) Using the table, titled "Monthly and Yearly Runoff, in inches (adjusted)", the average monthly streamflow in cubic feet per second was computed using the formula:

$$Q = \frac{(\text{Runoff(in/month)}/(12\ \text{in/ft}) \times (\text{DA(sq mi)} \times 27{,}878{,}400\ \text{sq ft/sq mi})}{24\ \text{hr/day} \times 3600\ \text{sec/hr}}$$

The drainage area at the gage is 324 square miles.

2) The values from the table, titled "Monthly and Yearly Mean Discharges, in cubic feet per second (observed)", were then subtracted from the monthly average stream flows, computed in step 1 above, to arrive at an estimated mean monthly water supply withdrawal in cfs.

3) The average daily withdrawals were computed by dividing the mean monthly withdrawal, from step 2 above, by the number of days in the month.

The average daily withdrawals for the period October 1960 through September 1988 are published in the yearly U.S. Geological Survey Water-Data reports.

All the average daily withdrawal values from October 1929 through September 1988 were loaded into a computer file. The observed daily flow values for the same period were down loaded from the USGS computer system to the SRBC system. A BASIC computer program was developed to add the average daily withdrawal for each month to each of the observed daily flow values for the same month. The result was a data file that contained daily flow values which approximate the natural daily flow for the period of record.

The USGS standard statistical analysis programs were run on both the observed and the adjusted discharge records. Flow duration curves were computed and plotted, and 7-day, 10-year low flow (Q7-10) values were computed.

RESULTS

The adjusted record of mean annual flow for each climatic year is shown in table 1.

The flow duration curve for the observed record is compared to the flow duration curve for the adjusted record in figure 1. The adjusted 7-day average low flow for each year is plotted in figure 2. The plot appears to show that there is no time trend in the adjusted data.

The average flow, based on the observed record, is 403 cfs. The average flow, based on the adjusted record, is 417 cfs. The 7-day, 10-year low flow (Q7-10), based on the observed data, is 30.1 cfs, or 0.093 csm. The Q7-10, based on the adjusted daily flows, is 53.8 cfs, or 0.166 csm. Adjustment of the observed record for the effects of the diversion increases the Q7-10 by 23.7 cfs, or 0.073 csm.

CONCLUSIONS

The adjusted flows and statistics, based on those adjusted flows, should be used in any hydrologic studies and water resource management activities which require natural flows. These adjusted flows are still an approximation of the natural flows. Computation of the true natural flows would require daily withdrawal data for about 60 years-of-record. The approximations described above are believed to be adequate to meet present needs.

The adjusted flows show that there is a significant effect of the Lancaster City water supply withdrawal in the reach of the Conestoga River between the withdrawal point and the Lancaster Sewage Treatment Plant.

TABLE 1.--Adjusted annual mean flows, Conestoga River at Lancaster, Pa. (01576500)

Climatological Year (ending in March)	Mean Discharge cfs	Climatological Year (ending in March)	Mean Discharge cfs
1930	361	1960	300
1931	156	1961	471
1932	202	1962	417
1934	583	1963	316
1935	532	1964	254
1936	451	1965	277
1937	355	1966	178
1938	385	1967	236
1939	444	1968	304
1940	292	1969	272
1941	423	1970	350
1942	179	1971	549
1943	597	1972	481
1944	326	1973	805
1945	367	1974	523
1946	555	1975	429
1947	335	1976	712
1948	369	1977	435
1949	515	1978	601
1950	289	1979	577
1951	481	1980	459
1952	450	1981	258
1953	682	1982	213
1954	401	1983	366
1955	243	1984	618
1956	423	1985	457
1957	383	1986	352
1958	327	1987	422
1959	386	1988	426

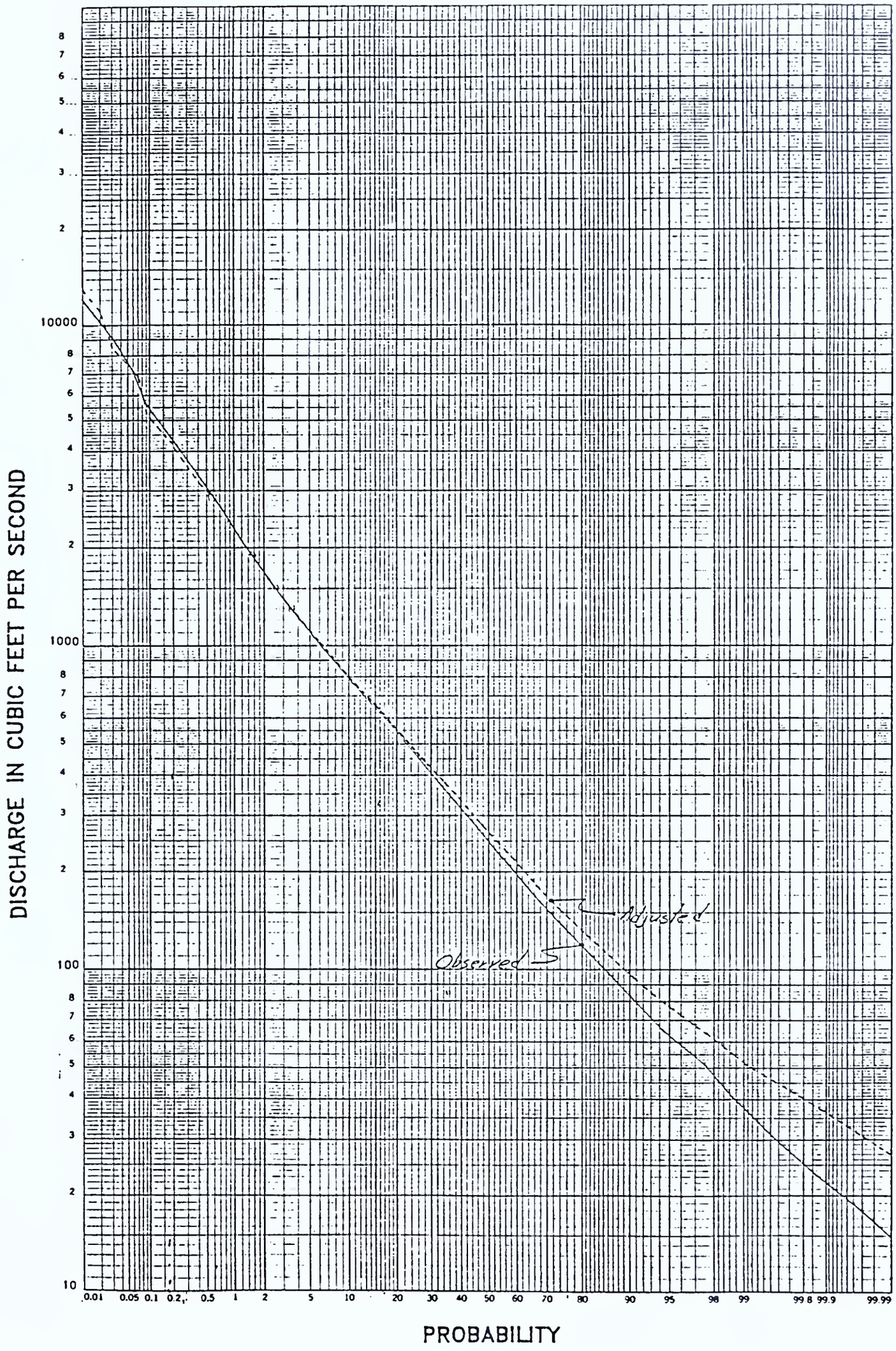

FIGURE 1.--Flow duration curves, Conestoga River

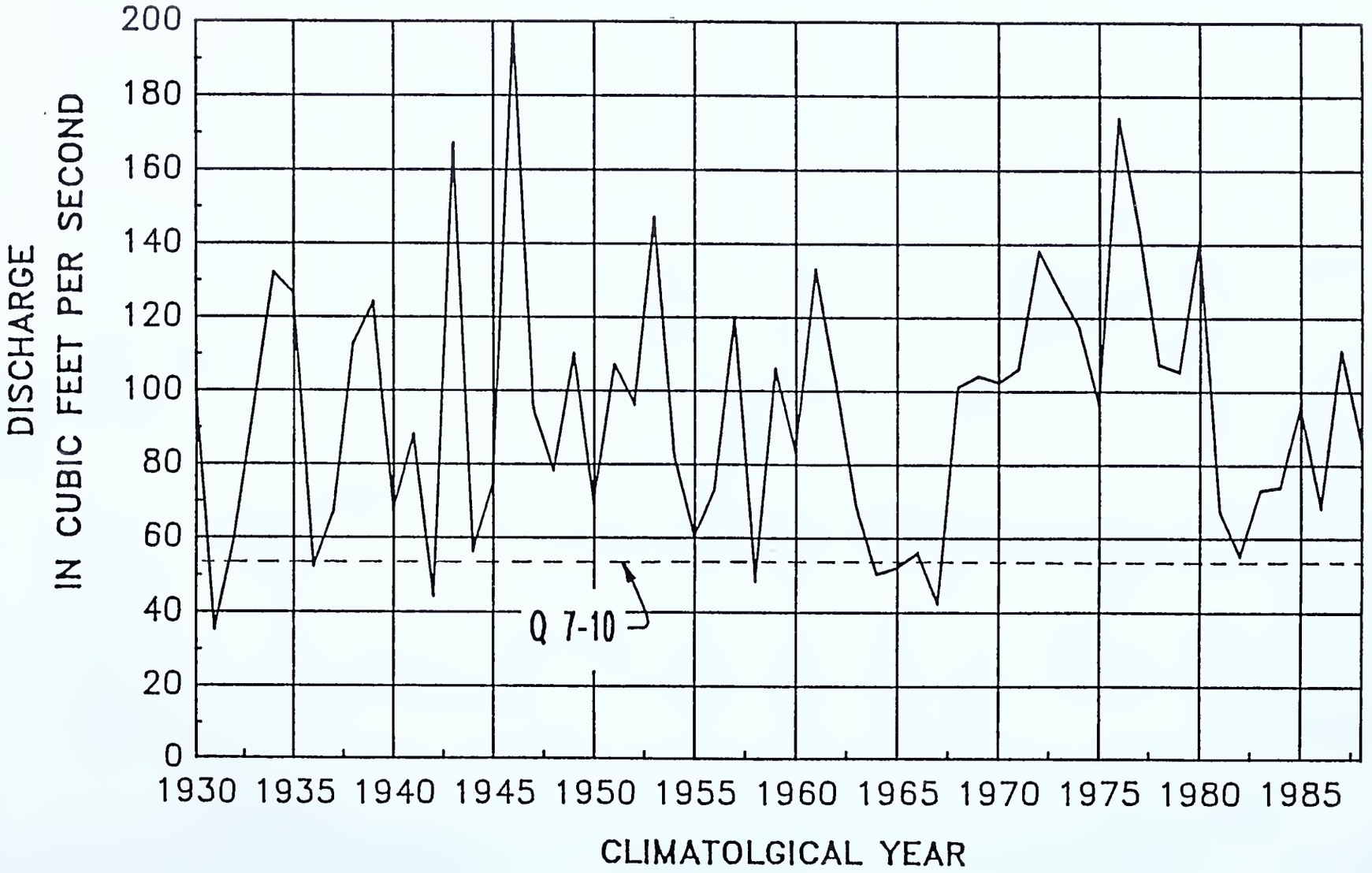

FIGURE 2.--Adjusted 7-day average annual low flow, Conestoga River

DATA AVAILABILITY

The adjusted mean daily flows for the entire period-of-record may be obtained by contacting the Chief of Planning and Operations.


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